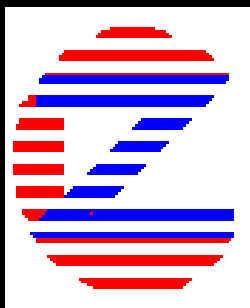


# Comparison of Stable Reversed-Phase Columns Including Zirconia, Silica, Alumina, Polymer and Carbon Based Packing Materials

by

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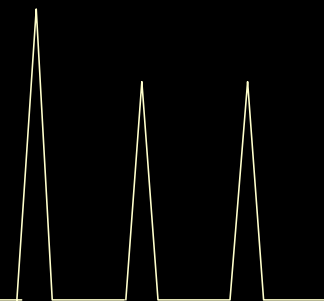


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# *OUTLINE*

- Columns Studied
- Column Characteristics
- Selected Solute Retention and Efficiency Comparison
- Selectivity Comparisons
- PCA of 21 probe solutes on 5 “high-stability” RP columns
- Conclusions

# *The Columns*

<i>Manufacturer</i>	ZirChrom	ZirChrom	Polymer Labs	Hewlett-Packard	ES Industries
<i>Description</i>	ZirChrom-PBD	ZirChrom-CARB	PLRP-S	Zorbax 300SB-C18	GammaBond RP-1
<i>Particle Size</i>	3	3	5	3.5	5
<i>Pore Size</i>	300	300	100	300	80
<i>Dimensions (mm)</i>	150 x 4.6	150 x 4.6	150 x 4.6	150 x 4.6	150 x 4.6
<i>Price</i>	\$595.00	\$695.00	\$480.00	\$425.00	\$695.00
<i>Low pH</i>	1	1	1	1.8	1.3
<i>High pH</i>	14	14	14	8	12
<i>High Temp Limit</i>	200	200	150	80	NA

# *The Conditions*

Mobile phase, 40/60 Acetonitrile/Buffer (50mM phosphate @ pH 3.2),  
Flow rate, 1.0 ml/min., Temperature = 21°C, Detection @ 254nm,

# Packing Characteristics Comparison

	Silica	Zirconia	Polymeric phase	Alumina	Carbon
Pore structure	++	++	+	++	+
Particle size	++	++	++	++	++
Chemical flexibility	++	+	+	+	--
Surface homogeneity	--	--	+	--	--
Mechanical stability	++	++	+	++	++
Swellibility	++	++	--	++	++
Chemical stability	--	++	++	+	++
Thermal stability	+	++	+	++	++

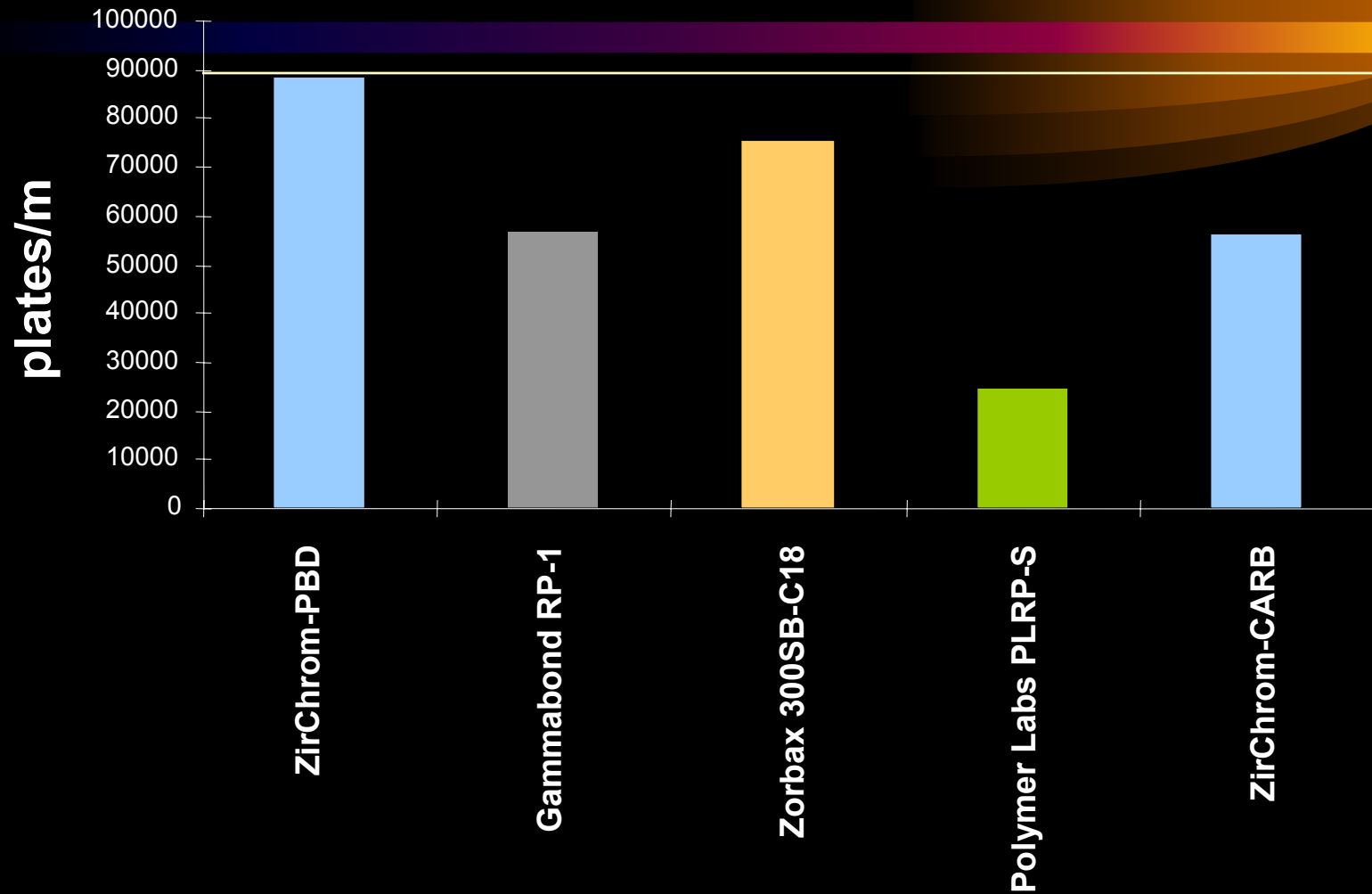
++ = excellent; + = good; -- = fair.

# *Selected Probe Solutes Column Efficiency Comparison*

Mobile phase, 65/35 Acetonitrile/Buffer (50mM phosphate @ pH 3.2),  
Flow rate, 1.0 ml/min., Temperature = 21°C, Detection @ 254nm,  
Solute concentrations, uracil = 0.04 mg/ml, phenol = 0.4, pyridine =  
0.15 mg/ml , 4-butylbenzoic acid 0.30 mg/ml, N,N - dimethylaniline  
= 0.15 mg/ml, Toluene = 4 mg/ml.

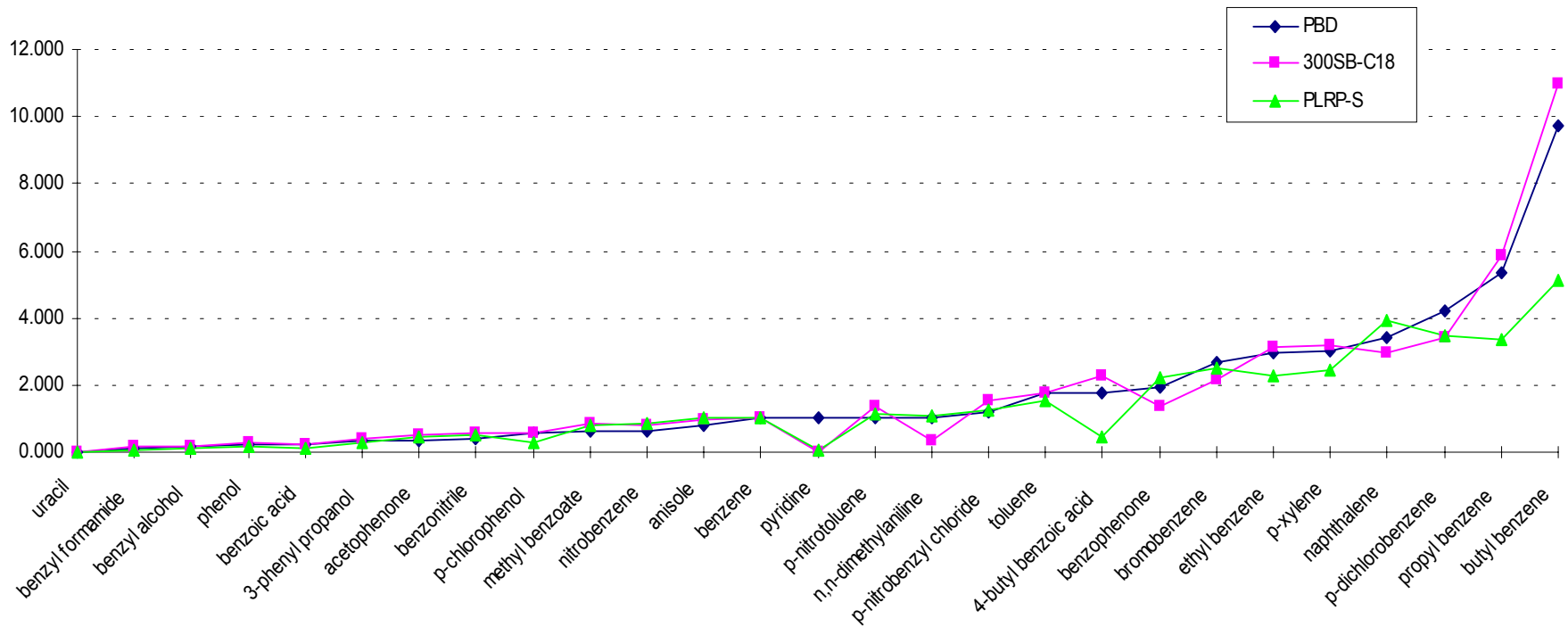
*LC-GC, Vol 13, No. 9, September 1995, 720-726.*

# *Average Column Efficiency\**



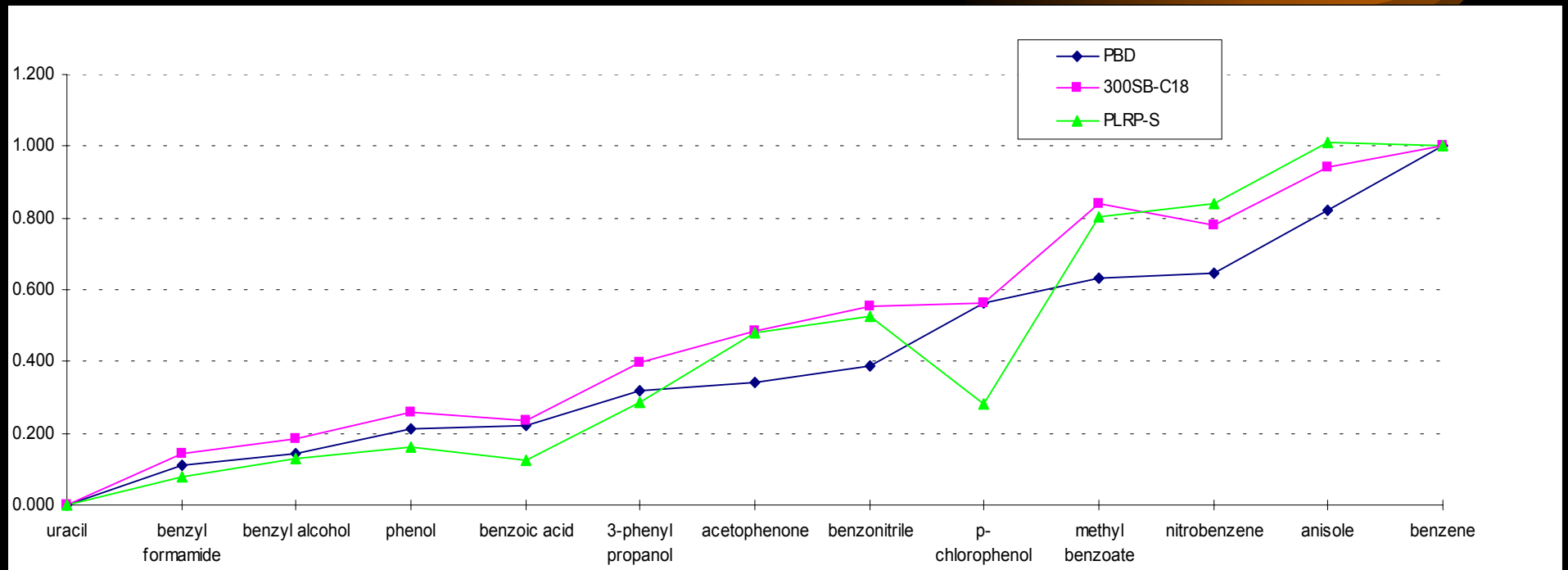
\* Column names are the trademarks of their respective manufacturers.

# Normalized Selectivity Comparison\* : ZirChrom-PBD, 300SB-C18, PLRP-S



\* Column names are the trademarks of their respective manufacturers.

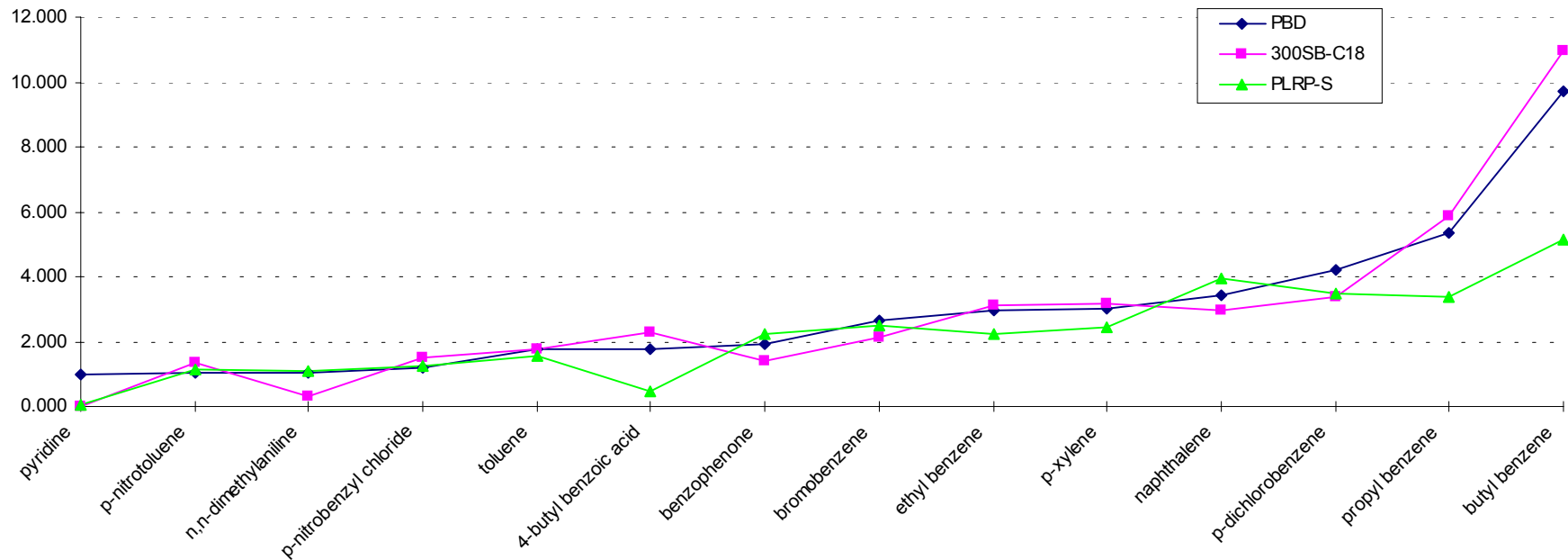
# Normalized Selectivity Comparison\* : ZirChrom-PBD, 300SB-C18, PLRP-S



\* Column names are the trademarks of their respective manufacturers.

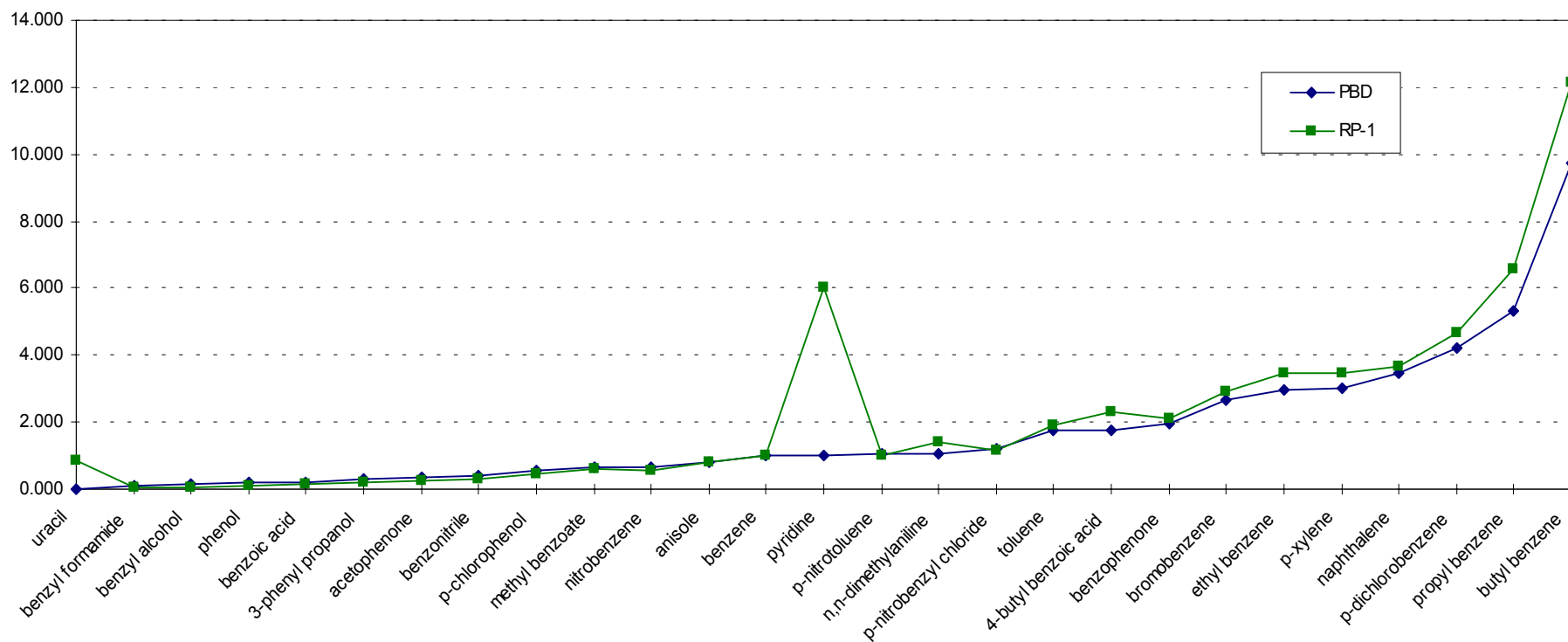


# Normalized Retention Factor\* : ZirChrom-PBD, 300SB-C18, PLRP-S



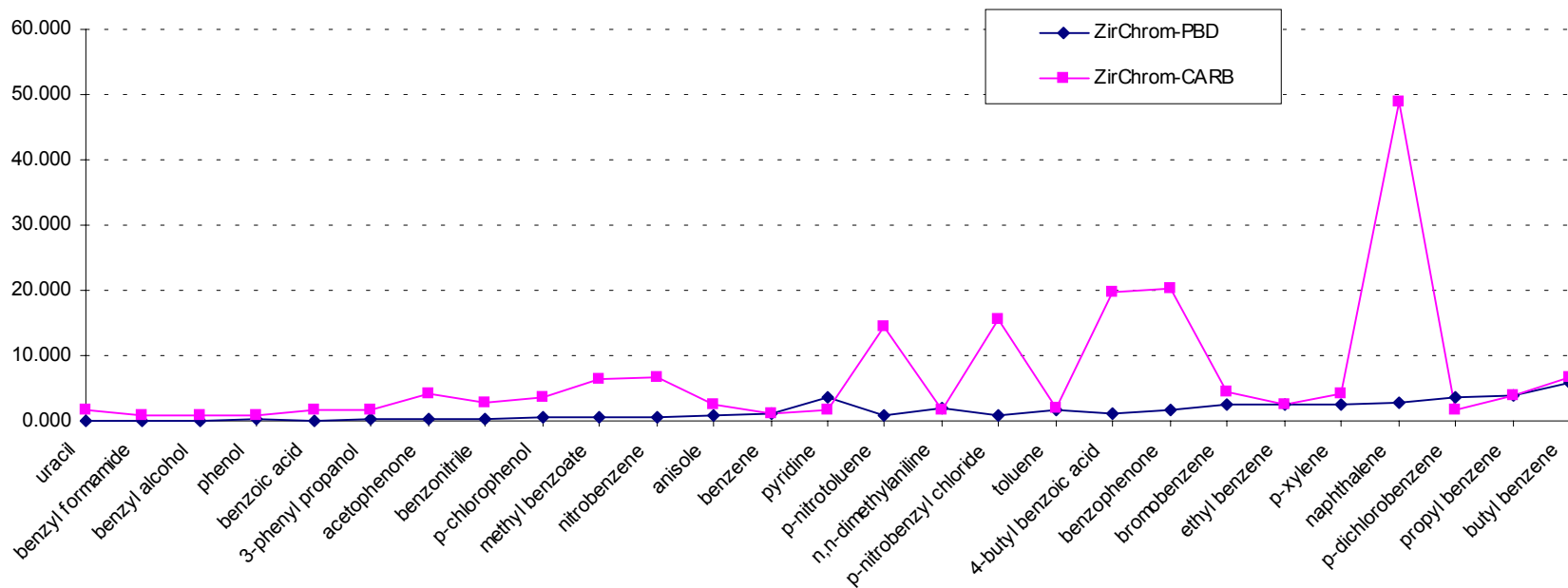
\* Column names are the trademarks of their respective manufacturers.

# Normalized Retention Factor\* : ZirChrom-PBD and Gammabond RP-1

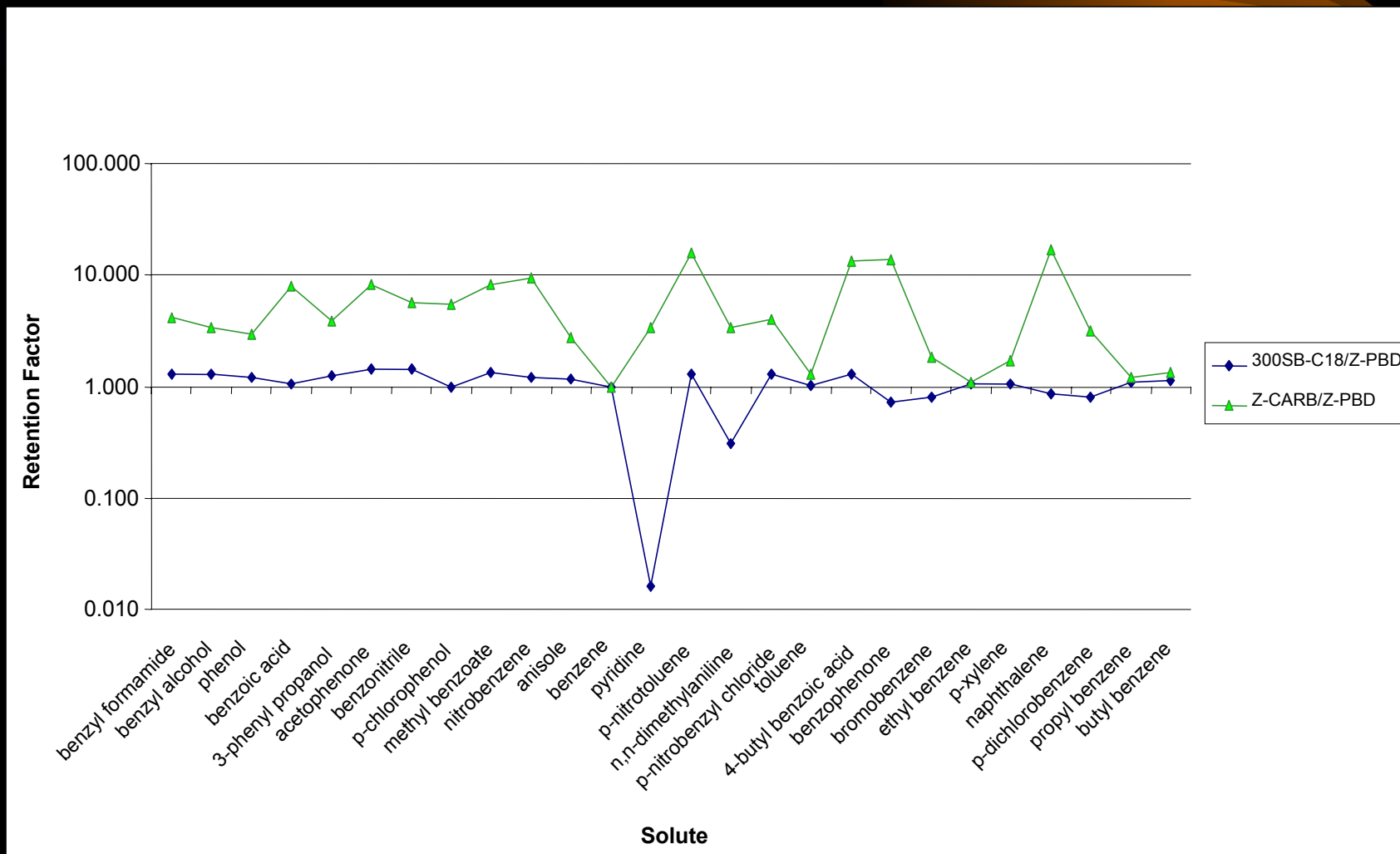


\* Column names are the trademarks of their respective manufacturers.

# Normalized Retention Factor : ZirChrom<sup>®</sup>-PBD and ZirChrom<sup>®</sup>-CARB



# Normalized Selectivity Comparison\* : ZirChrom<sup>®</sup>-PBD and ZirChrom<sup>®</sup>-CARB



\* Column names are the trademarks of their respective manufacturers.

# *ZirChrom PCA Study*

- Log  $k'$  values from each stationary phase are mean-centered before PCA to remove the variance contribution from possible non-constant phase ratio on different stationary phases.
- A total of twenty-one solutes are used for the PCA study.
- Mobile phase: 40% acetonitrile / 60 % 50mM phosphate @ pH 3.2.
- Temperature : 21°C.
- UV Detection @ 254 nm

# PCA Results on “Stable” Columns\*

Correlation	PBD	CARB	300SB-C18	PLRP-S	RP-1
ZirChrom-PBD	1				
ZirChrom-CARB	0.697	1			
Zorbax 300SB-C18	0.989	0.675	1		
Polymer Labs PLRP-S	0.967	0.764	0.957	1	
Gammabond RP-1	0.998	0.703	0.987	0.974	1

## PCA on mean-centered logk' values

No. of Principal Component	Eigenvalue	Var. Expl. (%)	Total Var. Expl. (%)	Res. Std. Dev.
1	22.960	89.929	89.929	0.175
2	2.341	9.168	99.096	0.061
3	0.157	0.615	99.711	0.042
4	0.063	0.246	99.957	0.023
5	0.011	0.043	100.000	0.000

## Regression on HP-Zorbax

Stationary Phase	Intercept	Slope	Std. Error	Corr. Coef.
ZirChrom-PBD	-0.42 ± 0.02	1.09 ± 0.04	0.076	0.989
ZirChrom-CARB	0.37 ± 0.12	0.78 ± 0.20	0.393	0.675
Polymer Labs PLRP-S	0.26 ± 0.04	0.98 ± 0.07	0.137	0.957
Gammabond RP-1	-1.50 ± 0.03	1.31 ± 0.05	0.097	0.987

\* Column names are the trademarks of their respective manufacturers.

# PCA Results on Silica Columns\*

Correlation					
	<i>SB300-C18</i>	<i>Zorbax Rx-C18</i>	<i>Hypersil C18</i>	<i>Hypersil C8</i>	<i>Zorbax C8</i>
Zorbax SB300-C18	1				
Zorbax Rx-C18	0.9989	1			
Hypersil C18	0.9998	0.9992	1		
Hypersil C8	0.9995	0.9982	0.9996	1	
Zorbax C8	0.9990	0.9974	0.9993	0.9998	1

PCA on mean-centered logk' values				
No. of Principal Component	Eigenvalue	Var. Expl. (%)	Total Var. Expl. (%)	Res. Std. Dev.
1	16.163	99.92	99.92	0.012
2	0.010	0.06	99.99	0.006
3	0.002	0.01	100.00	0.004
4	0.001	0.00	100.00	0.003
5	0.000	0.00	100.00	0.000

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## *Conclusions*

- ZirChrom<sup>®</sup>-PBD was the most efficient column tested and the polymeric PLRP-S column was the least efficient.
- ZirChrom<sup>®</sup>-PBD, Gammabond<sup>®</sup> and Zorbax<sup>®</sup> were all similar in their chemical selectivity.
- Carbon based columns should be used to get the largest change in reversed-phase chemical selectivity.
- The PCA study showed 4 principal components necessary to describe retention on the “stable” columns, whereas there was only 1 principal component for 5 silica reversed-phase columns.